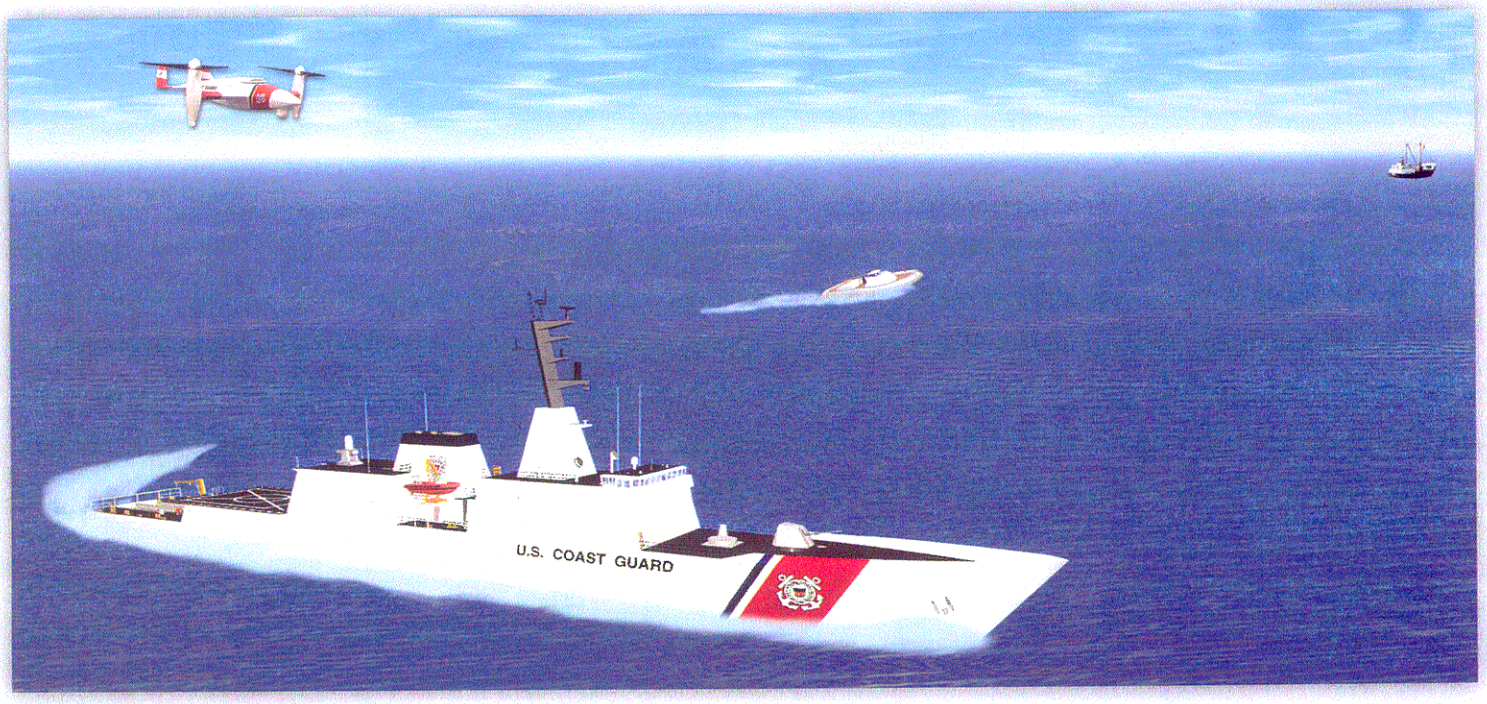
Eagle Eye VUAV: Reporting for Duty

By Gordon I. Peterson



Eagle Eye departs a National Security Cutter.

The officer of the deck ordered a course change to bring the bow of the U.S. Coast Guard's new 424-foot National Security Cutter (NSC) to a bearing providing optimal wind across the flight deck.

"Call away flight quarters," he ordered. Given the increasingly ruthless measures drug warlords were taking to prevent apprehension, the cutter's commanding officer wanted airborne "eyes on target" before undertaking any potentially dangerous boarding and inspection.

Within minutes, final system checks were completed on the cutter's Eagle Eye tiltrotor Vertical Take-Off and Landing (VTOL) Unmanned Aerial Vehicle (UAV). The flight deck was cleared of personnel. "Green deck, cleared to launch," was announced. The Eagle Eye took to the sky with a push of a button on the controller's console in CIC, the cutter's combat information center. It rose vertically, began its climb to 8,000 feet, transitioned to fixed-wing mode, and commenced its programmed flight plan to search a triangular-shaped area extending well beyond the cutter's visual horizon.

In CIC, the operations officer monitored encrypted telemetry from the Eagle Eye's multimode surface/air-search radar and EO/IR systems. A "fast mover" more than 80 miles away was spotted. The Eagle Eye was directed to intercept the craft. This is done by simply clicking and dragging the computer's mouse to place the computer's cursor on the new target.

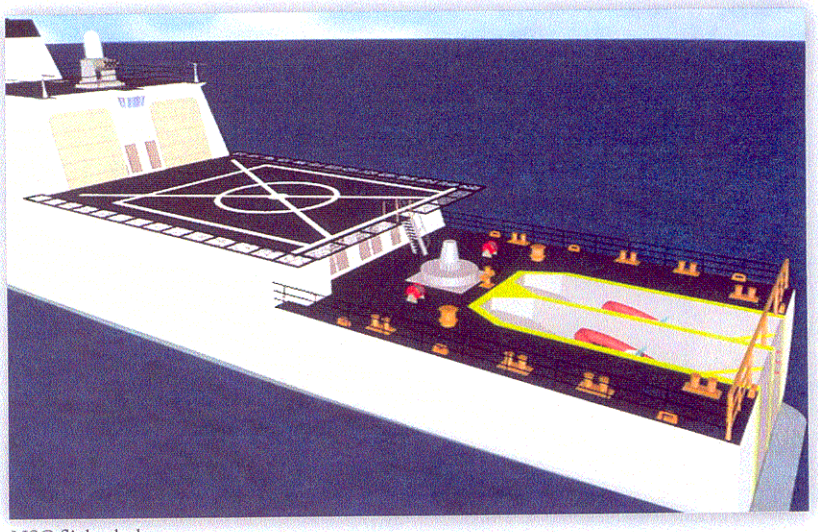
Flying at a dash speed of more than 200 knots, the Eagle Eye reached its prey in 22 minutes. The controller pushed another button, and the Eagle Eye banked and settled into a 90-knot orbit overhead. The operator then shifted the Eagle Eye's EO/IR sensor to fixed-camera mode to obtain digital imagery to identify and classify the craft. Within minutes its name and registry number were clearly displayed on one of the console's two video screens — and on another video screen on the cutter's bridge. Readouts for the Eagle Eye's operating systems were displayed on the controller's other screen.

"We have the pleasure craft IDLE DAYS out of Key West," the controller concluded. "Two adults, three kids, and a dog on board," he said. "Roger," the ops boss replied. "Get Eagle Eye back on its flight plan and continue surveillance. It's a target-rich environment, and we have four hours to go on this mission."

The foregoing operational scenario will be within reach in three years when the U.S. Coast Guard's Integrated Deepwater System's (IDS) first NSC and its embarked Bell Helicopter Textron HV-911 Eagle Eye tiltrotor VTOL UAVs (VUAV) are delivered to the fleet.

"Eagle Eye's cutting-edge technology is going to open a new and exciting future for Coast Guard aviation," said Lt. Cmdr. Troy Beshears, the Coast Guard's platform manager for unmanned aerial vehicles.

The Coast Guard's 20-year, $17 billion Deepwater program is an integrated "system-of-systems" approach to upgrade existing surface and air legacy assets while developing new and more capable platforms — including highly improved systems for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) and advanced logistics capabilities. The complex job is being handled by Integrated Coast Guard Systems (ICGS), a joint venture between Lockheed Martin and Northrop Grumman.



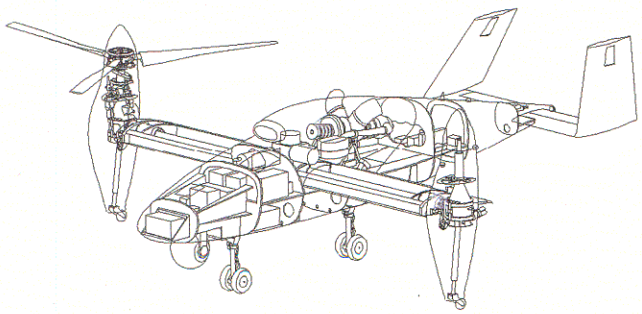
NSC flight deck.

When the Deepwater program is fully implemented, the total IDS system will consist of three classes of new cutters and their associated small boats, a new and upgraded fixed-wing manned aircraft fleet, a combination of new and upgraded helicopters, and both cutter-based and land-based UAVs.

Current planning calls for a total of 69 Eagle Eye VUAVs to be procured over the life of the Deepwater program. Bell Helicopter's flight testing of the first full-scale Eagle Eye prototype is slated to begin in 2005. With $50 million in UAV funding approved by Congress for the Deepwater program in Fiscal Year 2004, the Coast Guard is on track to receive its first eight Eagle Eye systems in FY2006 — three earmarked for initial operational testing and evaluation, and five slated for fleet use.

Modern Deepwater national security and offshore patrol cutters with a manned helicopter embarked will typically deploy with two Eagle Eyes; those without a manned rotorcraft will deploy with four of the VUAVs. It is envisioned that older high- and medium-endurance legacy cutters will deploy with two Eagle Eyes owing to their limited hangar space.

Eagle Eye will satisfy the Coast Guard's requirement for a tactical cutter-based UAV capable of bolstering surveillance and intelligence-gathering capabilities for the detection, identification, and classification of targets at ranges out to 100 nautical miles. Shore basing could open interesting possibilities for expanded collaboration with the new Department of Homeland Security (DHS) and the Department of Defense.



Eagle Eye exposed.

An Operator's Perspective

Beshears brings a naval aviator's operational perspective to his multiple responsibilities for assessing Coast Guard UAV requirements, evaluating existing platforms, and maintaining a continuing dialogue on UAV developments with the DHS, the U.S. defense establishment and the international community.

Although he is a member of the Operations Directorate at Coast Guard Headquarters in Washington, D.C., he is assigned to the staff of the Navy Unmanned Aerial Vehicles Program Office (PMA 263) at Patuxent River, MD.

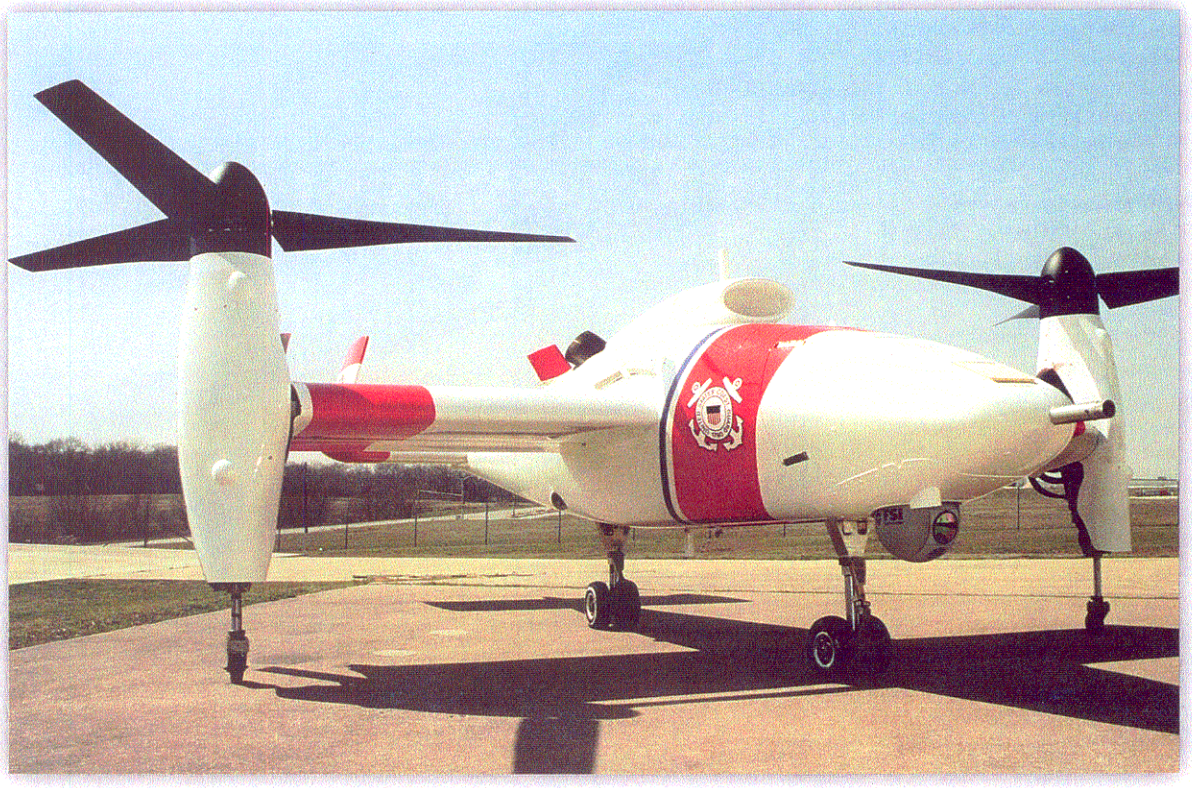
"This arrangement is advantageous for the Coast Guard and the Navy," Beshears explains, "because the Navy has an entire acquisition office working on unmanned aerial vehicles suitable for the maritime domain. There are many opportunities to leverage our work cooperatively and to harmonize our respective programs."

Much of Beshears' past 18 months supporting the Deepwater UAV program entailed validating Eagle Eye's suitability for meeting Coast Guard operational requirements. Hard-nosed comparisons with other rotary and fixed-wing UAV variants convinced him that Eagle Eye is the best choice for the Coast Guard for several reasons.

"While there are some similarities in any UAV mission set," Beshears explained, "the Coast Guard's multi-mission requirements differ in many respects from the other armed forces."

During a national-defense, law-enforcement, or homeland-security mission, for example, a Coast Guard cutter requires a UAV able to be launched for a fast transit out to 100 nautical miles — to surveil a vast coastal or open-ocean search area, dash quickly to intercept high-value targets of opportunity, loiter overhead if necessary, and return for a vertical landing on a small flight deck in up to sea state five conditions.

Eagle Eye's demonstrated tiltrotor technology combines the most advantageous operational characteristics of its fixed-wing and



Eagle Eye at ease.

rotary-wing counterparts — the higher airspeed, range, endurance, and sensor payloads of the former with the landing versatility of the latter.

"Eagle Eye offers tactical versatility for operating in the Coast Guard's maritime environment," Beshears explained. "Deepwater's tiered combination of using manned and unmanned aerial platforms to meet the Coast Guard's system-of-systems requirements is a solid approach."

The Eagle Eye's low center of gravity, inherent dynamic stability, and ease of access and maintenance also are appealing characteristics for shipboard use.

Persistent Surveillance

Beshears is optimistic that Eagle Eye will significantly improve the Coast Guard's persistent surveillance capability — a critical factor in the Coast Guard's ability to achieve the levels of maritime domain awareness needed to implement its layered defense-in-depth strategy for maritime homeland security.

With each Eagle Eye projected to fly 1,200 hours annually, the Coast Guard estimates a two- to three-fold improvement in its open-water surveillance effectiveness for a typical cutter deployed with a single helicopter and two Eagle Eye VUAVs. Its intelligence-gathering and radio-relay capabilities also will improve safety for boarding parties and small boat crews operating at some distance from their parent cutter.

In keeping with the Deepwater program's twin goals, Eagle Eye also is projected to achieve the greatest operational effectiveness of its competitors at the lowest total-ownership cost. "It remains to be seen at this comparatively early point in the program," Beshears said, "but my expectation is that Eagle Eye will deliver as planned."

His optimism is based, in part, on Bell Helicopter's initial flight tests (for the Navy) of a 7/8th-scale operating Eagle Eye model during 1998. "It had more than 55 hours in the air less than 90 days after its first flight, cruised at 14,600 feet with a 200-pound payload, and reached more than 200 knots true air speed," said Beshears. "Bell's design came in under schedule, under weight, and under budget — a big plus for a comparatively small UAV when every ounce matters."

Safety and reliability also are forecasted to be high. Bell Helicopter predicts a greater than 3,000-hour mean time between removal. Maintenance man-hours per flight hour are estimated at just over one hour.

Eagle Eye's operating systems are comparatively simple — a highly reliable Pratt and Whitney 200-55 turboshaft engine, a robust transmission (now in its final phase of test-bed testing), two short drive shafts, two 90-degree gear boxes for its variable-pitch rotors, a Sierra Nevada UCARS (UAV Common Approach and Recovery System) landing system, and an onboard computer.

Inspecting Eagle Eye transmission part.

Eagle Eye has no hydraulic systems; flight controls are operated by electro-servo actuators, and its twin tiltrotors are operated mechanically. Its innovative, retractable deck-securing system (to reduce parasitic drag) features a proven "two-claw" design suitable for the NATO landing grid that will be used on all Coast Guard cutters.

"When the operator signals Eagle Eye to land," Beshears related, "the UCARS interacts with the UAV's on-board computer to measure several aerodynamic and landing variables. As Eagle Eye approaches for landing, its two claws come down to grip the flight-deck grid after touch down. UCARS has been tested — it is accurate and reliable."

The 200-pound sensor package planned for Eagle Eye includes an EO/FLIR [electro-optical/forward-looking infrared] Star Safire III system, a version of the Telephonics RDR-1700 air-to-air/air-to-surface/weather multimode radar, fully integrated inertial GPS (global positioning system), encryptable digital data links, and UHF/VHF radio-relay capability.

Deepwater's ongoing C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) program will ensure that Eagle Eye's data stream and intelligence products can be shared widely with all Coast Guard units and other agencies.

"The real interoperability key is moving that data seamlessly between the Coast Guard, the DHS, DOD, and their agencies so that it can be evaluated and acted upon in a more timely and effective way," said Beshears.

In addition to line-of-sight transmissions to its parent cutter, it is possible that Eagle Eye's data could be transmitted directly to another site — a manned maritime patrol aircraft, for example, outfitted with a remote console.

FAA Certification

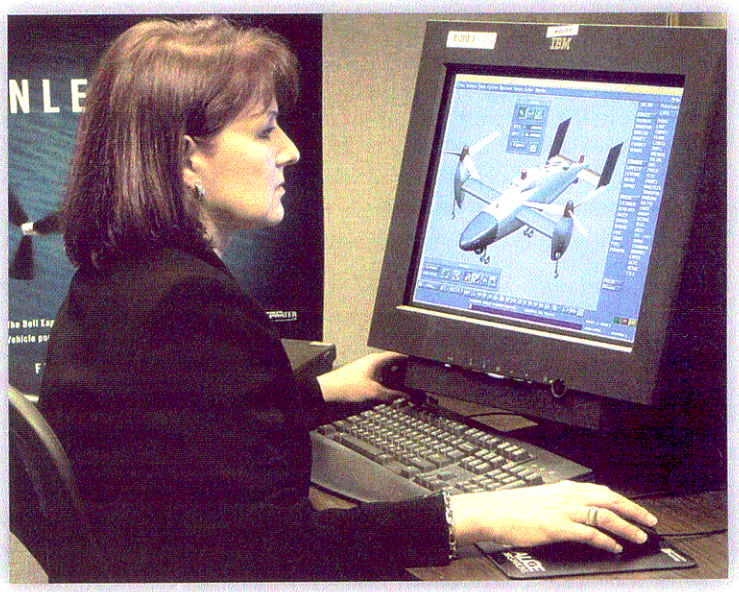
The Federal Aviation Administration (FAA) must certify Eagle Eye for operations in controlled U.S. airspace if the Deepwater program is to meet the Coast Guard's goal of initial VUAV operational capability in 2006.

The Coast Guard's VUAV integrated product team has established a working group to address FAA requirements and developed risk-mitigation activities. These operations include monitoring of and participation in FAA and other studies on UAV operations.

"We have Coast Guard personnel on virtually every airspace-deconfliction team that exists," Beshears said, "be it the FAA, Air Force, Navy, Army, Department of Defense, or industry."

As the Coast Guard regularly operates in U.S. coastal waters and controlled civil airspace, FAA certification is critical to permit routine operations when Eagle Eye is introduced to the Coast Guard's inventory. Beshears said the Coast Guard will seek to satisfy the FAA's requirements for safety and "see-and-avoid" airspace deconfliction through a combination of the Eagle Eye's multimode air-to-air radar, its EO/FLIR sensors, controller qualifications, and operational procedures.

Routine Eagle Eye operations in civil airspace will depend upon development of FAA certifications (UAV operations are currently allowed in non-special-use airspace provided a FAA regional office grants a Certificate of Authorization (COA). COAs are granted on a case-by-case basis for a limited time period.)



Eagle's Eye view on computer-aided design system.

The Coast Guard, working in collaboration with ICGS, is continuing to study and coordinate with the FAA and other airspace deconfliction teams to determine the most effective approach to operate Eagle Eye safely under positive control in civil airspace.

Among the options under consideration are patterning controller qualifications on FAA certification requirements for operating manned aircraft in controlled airspace or assigning a "mission commander" to a VUAV detachment possessing similar qualifications.

No decisions have been made, and the Coast Guard is researching several options in ongoing studies. What is clear is that the policies and procedures eventually developed by the Coast Guard for its VUAV operations will ensure that Eagle Eye satisfies both Deepwater and FAA requirements for it to be operated safely in controlled airspace.

In addition to its "rules of the road" for operating in controlled airspace, Eagle Eye will have other safety features incorporated. "It will have a built-in safety procedure for control so that if it loses its radio link it will go into a safety mode and try to reestablish contact," Beshears said. "If it does not regain contact after a certain amount of time, it will return to a predetermined site — normally the ship."

Those familiar with the Eagle Eye program see a similarity with another period in Coast Guard aviation's history — the introduction of helicopters more than 50 years ago. "There are many parallels between that period and today's developments," Beshears related.

"The unmanned aerial vehicle is the next logical sequence in the Coast Guard's aviation capability."

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